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NOTES ON THE GEOLOGY OF THE HIGH PLAINS OF VICTORIA

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General Geomorphology

Considerable portions of the areas known in Victoria as high plains are not plains at all in the usual sense of that word. They are rather areas of subdued relief, only limited parts of which have the flatness of true plains. For an area of low relief to be regarded as a high plain in Victoria, an elevation of at least 4,500 ft above sea level is usually required, and though arbitrary, this definition is used in these notes as a general guide.

The high plains are all situated within the Eastern Highlands. Occurring there amid a steep deeply dissected landscape, their appearance still strikes the traveller as remarkable. The topographic forms which they display vary considerably—from true plains, broad rolling landscapes crossed by old, mature and even youthful valleys, to broad ridge tops and gently rounded mountain summits. But they have this in common: they are physiographically late mature to senile, and they are always surrounded by terrains of much greater relief, deeper dissection. From these surrounding regions of deep dissection, the high plains are being attacked by rejuvenated streams of the present cycle of erosion.

The approximate extent of the high plains is shown on the occompanying map (Fig. 1). Portions of some of the high plains areas drop below 4,500 ft—particularly in the Wellington Tablelands and the Limestone Cr.-Cobberas area—yet they are still all classed as high plains as they are definite morphogenetic units. Because it is so extensive in New South Wales, the Monaro Plateau is included, even though in Victoria it scarcely reaches above 3,500 ft. Because of their elevation, the Wulgulmerang Plateau and the broad ridges connecting it with the Cobberas are not regarded as high plains, nor are the plains of Cobungra, Omeo and Benambra, even though these are all physiographically related to accepted high plains.

The problem of the physiographic evolution of the high plains awaits detailed geological and geomorphological studies before it can be fully elucidated. The high plains shown on the accompanying map are basically the residuals of a once extensive ancient land surface, eroded to a stage of low relief or partial peneplanation before being uplifted and extensively destroyed by rejuvenated streams. Preservation of remnants of this old surface has been assisted by the presence of resistant rocks such as granite, Middle and Upper Devonian lavas, and Upper Devonian sandstones.

The old erosion surface originated at no great height above sea level during the early Mesozoic, probably in the Triassic Period (Hills 1955), and may therefore be termed the Triassic surface. Later in the Mesozoic, it began to up-warp in the region which is now the Eastern Highlands, with concomitant down-warping further S. which formed sedimentary basins in central and south Gippsland. By the beginning of the Tertiary, some broad deep valleys had been cut in the up-warping surface. Flow remnants at such places as the Dargo High Plains and the Nunyong

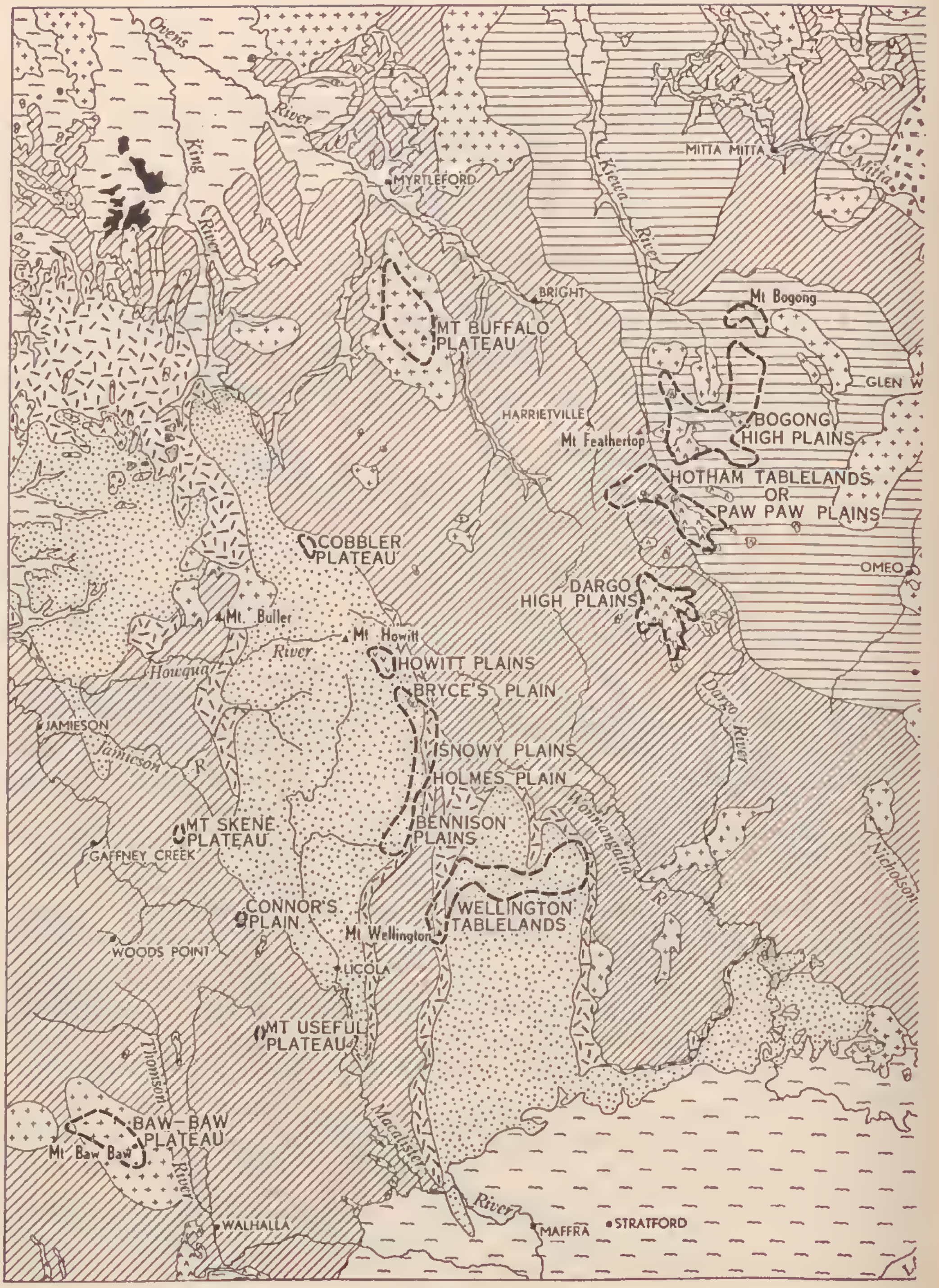
Ovens
River
King
River
MYRTLEFORD
Kiewa
River
MITTA MITTA
Mitta
BRIGHT
Mt Bogong
MT BUFFALO
PLATEAU
GLEN W
HARRIETVILLE
Mt Feathertop
BOGONG
HIGH PLAINS
HOTHAM TABLELANDS
OR
PAW PAW PLAINS
COBBLER
PLATEAU
OMEO
DARGO
HIGH PLAINS
Mt. Buller
Mt Howitt
River
Howqua
HOWITT PLAINS
BRYCE'S PLAIN
JAMIESON
Jamieson
R
SNOWY PLAINS
HOLMES PLAIN
Dargo
River
Wonnangatta
R
BENNISON
PLAINS
MT SKENE
PLATEAU
GAFFNEY CREEK
Nicholson
WELLINGTON
TABLELANDS
CONNOR'S
PLAIN
Mt Wellington
WOODS POINT
LICOLA
MT USEFUL
PLATEAU
Thomson
BAW-BAW
PLATEAU
Mt Baw Baw
River
Macalister
River
WALHALLA
MAFFRA
STRATFORD

Fig. 1

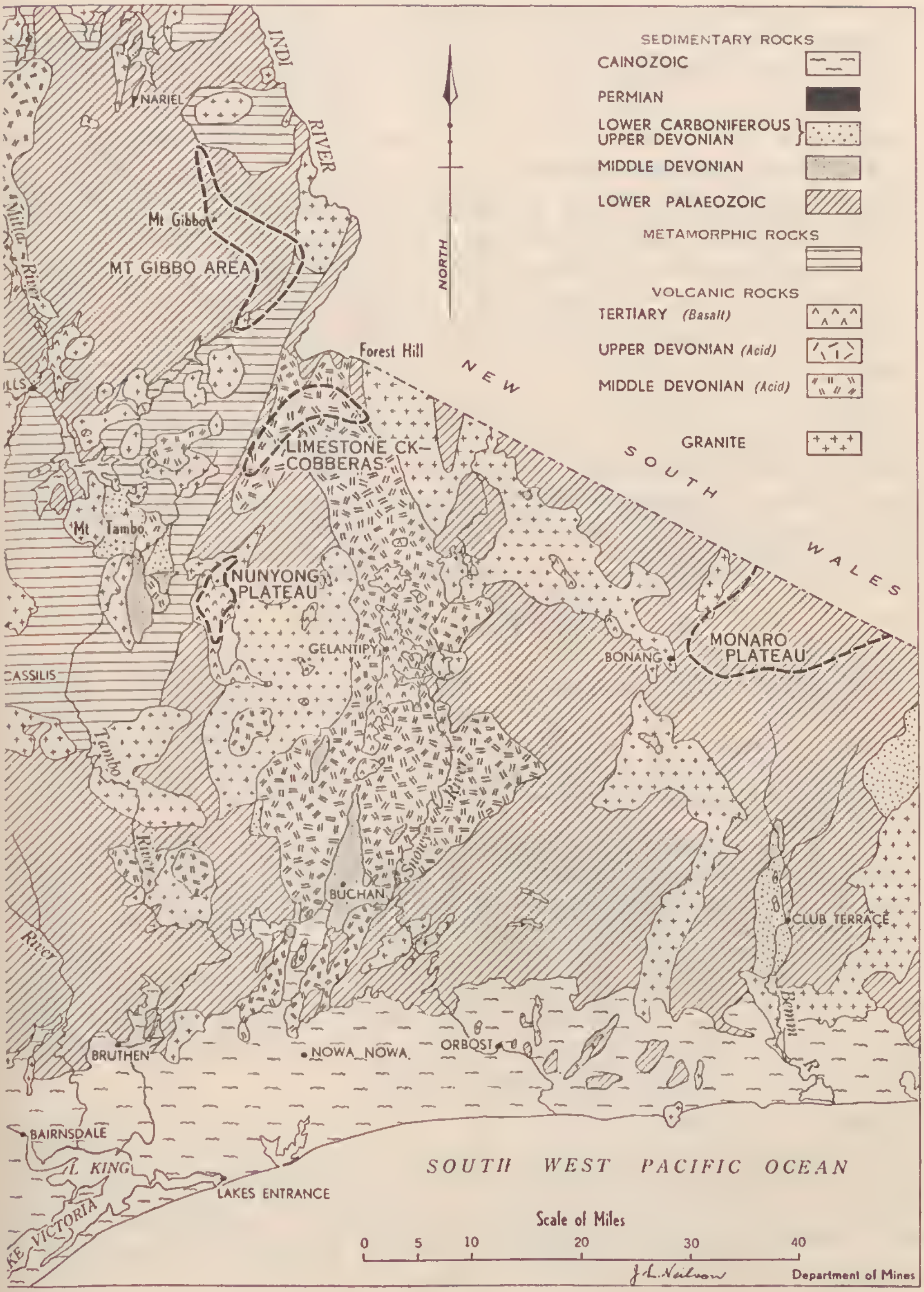
SEDIMENTARY ROCKS
CAINOZOIC
PERMIAN
LOWER CARBONIFEROUS
UPPER DEVONIAN
MIDDLE DEVONIAN
LOWER PALAEOZOIC
METAMORPHIC ROCKS
VOLCANIC ROCKS
TERTIARY (Basalt)
UPPER DEVONIAN (Acid)
MIDDLE DEVONIAN (Acid)
GRANITE
NORTH
INDI RIVER
NARIEL
Mt Gibbo
MT GIBBO AREA
Mitta River
Forest Hill
NEW SOUTH WALES
LLS
LIMESTONE CK–COBBERAS
Mt Tambo
NUNYONG PLATEAU
GELANTIPY
CASSILIS
Tambo River
MONARO PLATEAU
BONANG
Snowy River
BUCHAN
River
CLUB TERRACE
Bemm R.
BRUTHEN
NOWA NOWA
ORBOST
BAIRNSDALE
L. KING
LAKE VICTORIA
LAKES ENTRANCE
SOUTH WEST PACIFIC OCEAN
Scale of Miles
0 5 10 20 30 40
J.L. Neilson
Department of Mines

FIG. 1

Plateau indicate that basalt flowed down some of these valleys during Eocene-Oligocene times. However, not all the basalt flowed down valleys; some basalt cappings of the Bogong High Plains-Mt Hotham area rest on a fairly planar surface which must be the Triassic surface with little modification. The final phase of up-warping was the Kosciusko Uplift (Andrews 1910), which elevated the Eastern Highlands to their present altitude in the Upper Pliocene. With pulses of uplift occurring over such a prolonged period, streams have experienced phases of rejuvenation, which are attested by the valley in valley structures commonly found in the valleys of streams such as the Macallister R. and the Wonnangatta R. The rejuvenated streams, partly assisting active slope retreat, have reduced this once extensive land surface to the limited surviving areas now known as high plains.

It is possible that erosion surfaces of more than one age are represented in the high plains shown on the accompanying map. Baragwanath (1925) has recognized a younger erosion surface peripheral to the Baw Baw Plateau at about 3,500 ft, and while this can be traced to the head of the Yarra R., it has not been definitely recognized farther E., though it may be represented by the Monaro Plateau and the broad ridge tops of the Limestone Cr.-Cobberas area. The old Triassic surface, modified to some extent by erosion, is the main determining factor in the origin of most of the high plains. The extent of faulting in the Eastern Highlands is still largely unknown, though Beavis (1960, 1961) has demonstrated Cainozoic faulting in the Bogong area. Until more is known of Cainozoic faulting, certain correlation of separate high plain areas cannot be done in the absence of dateable deposits on their surfaces. Correlations made at present are largely provisional.

Geology of the High Plains

Monaro Plateau

The Monaro Plateau stretches into Victoria from New South Wales, where it is very extensive. It shows a broad rolling late mature topography; the streams crossing it generally have broad alluviated valleys, even near their heads, and carry water which flows northwards into the Snowy R. The plateau is bounded on the S. by very steep slopes and deep dissection, which contrast with the plateau topography.

The Monaro Plateau is cut in a terrain of steeply dipping argillaceous Lower Palaeozoic sediments, which at Delegate R. are intruded by granite. The drainage pattern, which is rectangular, appears to be influenced by strike ridges and possible cross faults. Soils on interfluves are usually red-brown and clayey, while black peaty soils are common on the river flats.

Mt Delegate (4,307 ft) rises about 1,000 ft above the plateau as a monadnock, with distinctive radial drainage. It is probably the only relic of the Triassic erosion surface present. The average height of the Monaro Plateau in Victoria is about 3,000 ft. Its age, somewhere within the Tertiary, hinges on the age and relationships of the basalt remnants of Nimitybelle and Bombala.

Limestone Cr.-Cobberas Area

The broad ridge tops around the Cobberas area and the head of Limestone Cr. have a general summit level of about 4,500 ft, and are the surviving remains of an erosion surface which is now maturely dissected. Steadily decreasing in altitude, this surface can be traced eastwards towards the Wulgulmerang Plateau. The remains of this surface are preserved mainly on a landscape of resistant lavas of the Snowy River Volcanics (Middle Devonian).

The Cobberas (6,025 ft) rises above this surface as a monadnock—probably belonging to the Triassic surface—while the 4,500 ft ridge top surface belongs to a younger erosion surface which may be equivalent to Baragwanath's 3,500 ft peneplain near the Baw Baws.

MT GIBBO AREA

The high plains of the Mt Gibbo really consist of a broad divide whose average height is almost 5,000 ft. The divide has gentle rises and falls, with Davey's Plain as the only flat area of any size. The highest points are the broad summits of Mt Gibbo (5,479 ft) and Mt Pinibar (5,811 ft). To the E. and W. dissection is deep, with the steep valleys of the Indi R. and Gibbo Cr. almost 3,000 ft below.

The Mt Gibbo area is a remnant of an erosion surface cut mainly in steeply dipping Lower Palaeozoic sedimentary rocks, and appears to be a slightly modified relic of the Triassic surface.

NUNYONG PLATEAU

The flat topography of the Nunyong Plateau, approximately 4,500 ft above sea level, is due to the presence of an extensive residual of Older Basalt (Eocene-Oligocene). The basalt appears to have flowed in a southerly direction down one of the mature valleys cut in the up-warping Triassic surface by early Tertiary time. Substantial uplift since the extrusion of the basalt has led to very deep dissection by the Tambo R. and the Buchan R. on either side. The Nunyong Plateau has only survived because of the superior resistance to erosion of the basalt, while the adjacent ranges of softer rocks have been worn down.

The basalt seems contemporaneous with the basalts of the Gelantipy Tableland farther E., but all these basalts appear to be valley flows, it is doubtful whether one vast basalt plateau once linked the Gelantipy Plateau with the Nunyong Plateau, as Stirling (1887) suggests.

BOGONG HIGH PLAINS

The Bogong High Plains situated a little to the N. of the Great Divide, are both the highest and the largest high plains in Victoria. They form a composite landscape of low relief, composed of remnants of an erosion surface which was cut in gneisses and granites, and cappings of Older Basalt (Eocene-Oligocene) lying upon this. The flattest part of the Bogong High Plains is the large basalt residual centred on Mt Jim (5,916 ft) which, when viewed from across the Cobungra R. at Mt Loch appears flat. The high plains finish before Mt Nelse (6,267 ft) is reached, but fairly flat spurs stretch out towards Mt Bogong, until truncated by the deep youthful valley of the Big R. Similar ridges are found spreading out in other directions from the high plains, and really belong to the same land surface as the high plains.

The streams flowing across the high plains have broad shallow valleys and gentle gradients, with moss bogs common, but on reaching the edge of the plains, gradients steepen and streams enter deep youthful valleys At the edge of the high plains, dissection is deep, and streams such as the Cobungra R., the Big R. and the heads of the Kiewa R. are rejuvenated and actively downcutting. Crohn (1950) mentions the importance of faulting in the rejuvenation of these streams; Beavis (1960, 1961) has further documented this faulting.

Across the Big R., in the environs of Mt Bogong (6,508 ft), is a limited area of low relief which seems to be part of the same land surface as the true Bogong High Plains, though rather higher.

The low relief landscape cut in metamorphics and granites is probably the Triassic land surface, slightly modified by erosion. The Older Basalt appears to be mainly sheet flows capping this old surface, but some of the basalt appears to occupy mature valleys cut in this surface by the early Tertiary.

HOTHAM TABLELANDS

The Hotham Tablelands are separated from the Bogong High Plains by the deep valleys of the Cobungra R. and the West Kiewa R. In the Mt Hotham area, they are represented by rounded ridge summits over 5,000 ft in elevation, with eminences such as Mt Hotham (6,101 ft) and Mt Loch (6,152 ft) rising slightly above the general level. Several miles E. of Mt Hotham, a change occurs, with broad rounded ridge summits changing to flat tableland topography on the Cobungra-Dargo divide. Here is the head of the Victoria R., and this flat tableland—of elevation 4,500-5,000 ft—is called the Paw Paw Plains by Stirling (1887). From the Paw Paw Plains, another tableland stretches eastwards along the Victoria-Cobungra divide, and eventually drops towards Cobungra.

The bedrock of the Hotham Tablelands is Ordovician slatey mudstone, which is fairly easily eroded when not protected by basalt cappings. Hence in the Mt Hotham area, where the only basalt is a small cap at Mt Loch, a general accordance of ridge levels is the only indiction of an erosion surface. From Mt Higginbotham (5,870 ft)to the Paw Paw Plains and beyond, thin basalt cappings are common, and give the landscape a flat tableland appearance. The basalt residuals seem to by plateau cappings rather than valley flows, though beneath the basalt of the Paw Paw Plains gravels indicate an old valley. The basalt has preserved remnants of the same erosion surface which is found on the Bogong High Plains.

DARGO HIGH PLAINS

On the divide between the deep valleys of the Upper Dargo R. and the Wongungarra R., S. of Mt Hotham, is a broad area of basalt tableland known as the Dargo High Plains, which connects with the Great Divide at Mt St Bernard by a narrow ridge of Ordovician slate. The elevation of the plains is about 4,500 ft, with a slight slope to the S.

The basalt fills broad and deep valleys cut below the level of the Triassic erosion surface; gravels beneath the basalt indicate a deep lead heading from sub-basaltic gravels at the Paw Paw Plains on the Great Divide. The basalt, like the basalt remnants further N., belong to the Lower Tertiary Older Volcanics.

The valleys crossing the plains are broad but shallow, with peaty flats and moss bogs common. Only at the edges of the plains where basalt cliffs occur, has rejuvenation reached the area. A peculiar feature of some of the valleys on the plains is a step-like effect, which is due to both jointing and flow boundaries in the basalt.

WELLINGTON TABLELANDS

The Wellington Tablelands occupy the upper and middle parts of the basin of the Moroka R., and extend a little S. of it to the Wellington Plateau. To the N. they are bounded by the junction of Little R. with the Moroka R., while to the W. they finish at the Big Plain (*c.* 4,700 ft) above the upper Moroka R. The tablelands finish in the E. at the top of a high scarp, from which spurs rapidly drop about 4,000 ft to the Wonnangatta R. They are linked with the Bennison Plains, and Holmes Plain by a narrow ridge. The Wellington Tablelands show broad rather rounded divide tops, broad valleys which are not deep, but few areas which are reasonably flat, apart from the Wellington Plateau and the Big Plain. S. of the tablelands surface in the Avon R. watershed, the steep valleys, sharp ridges and much deeper dissection make a strong contrast with the Wellington Tablelands.

The Wellington Tablelands lie within an area of resistant Upper Devonian sandstones and rhyolites, with moderately spaced folds and dips of 10-50°. At the E. edge, Ordovician slates and quartzites cut across the tablelands without causing change in relief.

Three main physiographic elements compose the Wellington Tablelands:

1. The broad ridge tops and summits at about 5,000 ft elevation, e.g. Wellington Plateau (Big Hill) (*c.* 5,000 ft), Mt Wellington trig. station (5,363 ft), Castle Hill (4,749 ft). They are slightly denuded relics of the Triassic erosion surface.
2. The Big Plain area (*c.* 4,800 ft). Adjacent to the upper Moroka R., this broad rolling area is an old broad strike valley (Thiele 1907), and represents the ancestral course of the Moroka R. The drainage now cuts across the strike to flow into the present Moroka. Its age is probably Lower Tertiary.
3. The Moroka Valley (*c.* 4,000-3,200 ft). From near the Mt Wellington trig. station, the upper Moroka Valley drops rapidly to the N. along a straight course, following the strike of the Upper Devonian rocks almost along the rhyolite-sandstone boundary. It is actively downcutting, and has captured the old strike drainage of the Big Plain.

   Dissection of the Big Plain by the Moroka is beginning but as the Moroka R. is cutting down more rapidly than the small streams crossing the Big Plain, these small streams tend to join the Moroka from waterfalls or hanging valleys. These hanging valleys and the straight head of the Moroka suggest glacial action to Costin (1957) but they are readily explained as above.

   The stream gradient soon lowers and the Moroka valley widens as it swings to the E. following the trends of plunging folds, to flow through a mature broad open valley, with river flats. Dissection is fairly shallow compared with the Avon Basin to the S. The Little R. flows westwards from Castle Hill to the Moroka through similar broad valley country with fairly shallow dissection. Both these broad valleys form a conspicuous saucer-like basin, which ends abruptly below the junction of the two streams, when the river begins to drop suddenly into a gorge.

Bennison Plains, Holmes Plain, Snowy Plains, Bryce's Plain

From the flats of Shaw's Cr., close to Mt Tamboritha (5,381 ft) extending about 16 miles to the N. is an unbroken sequence of high plains. It is a mildly undulating landscape, with broad valleys, often with alluvial flats, and gently sloping valley sides. High points such as Mt Reynard (*c.* 5,600 ft) and Mt Arbuckle (5,525 ft) rise gently above the general level. The most southern part, the Bennison Plains, has an elevation of about 4,500 ft, rising to almost 5,000 ft at Holmes Plain and a little over 5,000 ft at the Snowy Plains before a drop of several hundred feet to Bryce's Plain.

The geology is remarkably uniform, with northerly striking Upper Devonian rocks dipping westerly at low angles. Rhyolites of the same age outcrop near the eastern edge of the plains.

This belt of high plains is a survival of the Triassic land surface, which is here only shallowly dissected on the high plains by the remnants of an ancient drainage system. The streams of the old system have a N.-S. trend, which is determined by the strike and the gentle W. dip of sandstone beds belonging to a worn down cuesta landscape (Davis 1899). The valleys are broad, with alluvial flats and moss bogs.

To the E. and W. of the high plains, dissection by the Carey R. and tributaries of the Wonnangatta R. and the Caledonia R. is very deep. N. of Mt Arbuckle, a deep escarpment slope marks the eastern edge of the plains. During the present erosion cycle, vigorous heads of these streams have extensively captured the old strike drainage of the high plains. On the Snowy Plains, the old drainage system has been almost completely removed by capture, but further S., Shaw's Cr.—flowing close to the boundary between sandstone and rhyolite—survives.

HOWITT PLAINS

N. of Bryce's Plain, across a narrow neck, are found the remarkably flat Howitt Plains (*c.* 5,200 ft) from which heads the Caledonia R. They spread out northwards towards the broad summit of Mt Howitt (5,715 ft). The flat surface of the Howitt Plains is due to a capping of basalt, probably of Eocene-Oligocene age like the basalt of the Dargo Hill Plains. The basalt appears to lie on a fairly level surface.

COBBLER PLATEAU

The Cobbler Plateau (*c.* 5,300 ft) is composed of very gently dipping resistant pebbly sandstones of Upper Devonian age, and appears to be an exposed dip slope in these beds rather than an erosion surface remnant. It is surrounded on all sides but the S. with steep cliffs, which are steepest at the N. It connects with Mt Howitt to the S. via the serrated Crosscut Saw.

MT SKENE PLATEAU, MT USEFUL PLATEAU, CONNOR'S PLAIN

The flattened summit of Mt Skene (5,200 ft) composed of steeply dipping Silurian mudstones probably represents the slightly denuded Triassic surface.

Mt Useful (4,717 ft) and Connor's Plain (*c.* 4,500 ft) are both thin cappings of Older Basalt (Eocene-Oligocene) to which they owe their plateau-like summits.

MT BUFFALO PLATEAU, BAW BAW PLATEAU

Mt Buffalo stands as an isolated granite mass, with steep joint surfaces on most sides. The undulating summit which caps it has a general elevation of about 4,500 ft, while the highest point is The Horn (5,645 ft). Joints appear to determine the main drainage lines on the plateau.

The Baw Baw Plateau is remarkably similar to the Buffalo Plateau. It is cut in granite, its average level is about 4,500 ft, with Mt St Phillack (5,140 ft) as the highest point. The Baw Baw Plateau is undulating, and again, the stream pattern is determined by jointing (Baragwanath 1925). Both plateaux appear to be slightly dissected residuals from the Triassic land surface.

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